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H01L 21/52(21)Application number : **11-047507**(71)Applicant : **SUMITOMO BAKELITE CO LTD**(22)Date of filing : **25.02.1999**(72)Inventor : **TAKEDA TOSHIRO****(54) DIE-ATTACHING PASTE****(57)Abstract:**

PROBLEM TO BE SOLVED: To obtain a die-attaching paste not deteriorating in hot adhesive strength, is rapid-curing, and not causing void formation by including a thermosetting resin having a specified nitrogen content with an inorganic filler as the essential components.

SOLUTION: This paste contains a normally liquid thermosetting resin having a nitrogen content of 2-10 wt.% and an inorganic filler. The thermosetting resin comprises a liquid cyanate resin, an epoxy, resin, a like resin, a curing agent such as an aliphatic or aromatic amine, dicyandiamide, or a dicarboxylic dihydrazide, and a cure accelerator such as 2-methylimidazole or 2-phenylimidazole. The inorganic filler is exemplified by a silver powder or a silica filler. The silver powder desirably has a mean particle diameter of 2-10 μm and a content of impurities such as halide ions of 10 ppm or below, and the silica filler is one having a mean particle diameter of 1-20 μm . If required, the paste additionally contains additives such as a silane coupling agent, an antifoam, and a surfactant.

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CLAIMS

[Claim(s)]

[Claim 1] (A) The diamond touch paste characterized by the amount of the nitrogen atom which becomes considering thermosetting resin and (B) inorganic filler as an indispensable component, and is contained in thermosetting resin being 2 - 10 % of the weight.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the resin paste to which semiconductor devices, such as IC and LSI, are pasted up on a metal frame etc.

[0002]

[Description of the Prior Art] It has evolved with a transistor, IC and LSI, and a VLSI, by the latest remarkable development of the electronics industry, while the degree of integration of the circuit in these semiconductor devices increases rapidly, mass production method becomes possible, and the cost cut has posed an important problem with the spread of the semi-conductor products using these at the improvement list of the workability in the mass production. Conventionally, a semiconductor device is joined to conductors, such as a metal frame, by the Au-Si eutectic method, and, subsequently it closes with hermetic sealing, and, usually considered as the semi-conductor product. However, from the workability at the time of mass production, and the field of cost, a resin seal method is developed and current is generalized. In connection with this, the approach by the pewter ingredient, or a resin paste, i.e., the resin for mounting, came to be taken up as amelioration of the Au-Si eutectic method in a mounting process.

[0003] However, by the pewter method, that it is unreliable, to be easy to cause contamination of the electrode of a component, etc. are made into a fault, and use is restricted to the power transistor which requires high temperature conductivity, and the component of Power IC. On the other hand, the resin for mounting is excellent also in dependability etc. also in workability compared with the pewter method, and the need is growing rapidly.

[0004] Furthermore, a chip is being enlarged by the densification of degrees of integration, such as IC, in recent years. On the other hand, a copper frame has come to be used from the purpose of a cost cut from 42 alloy frame which has been used conventionally and which is a leadframe being expensive. If chip sizes, such as IC, become larger than about 4-5mm angle here, if an Au-Si eutectic method is used as a mounting method, the poor property by the crack and curvature of a chip will pose a problem from the difference of the coefficient of thermal expansion of a chip, and the coefficient of thermal expansion of a copper frame with heating like erectors, such as IC.

[0005] That is, this is because it becomes large with $20 \times 10^{-6}/\text{degree C}$ with a copper frame to the coefficient of thermal expansion of the silicon which is the ingredient of a chip being $3 \times 10^{-6}/\text{degree C}$ although it is $8 \times 10^{-6}/\text{degree C}$ with 42 alloy frame. On the other hand, by the conventional epoxy resin system paste, although it was possible to use the resin for mounting as a mounting method, in order to carry out three-dimensions hardening with thermosetting resin, a modulus of elasticity is high and it did not come to absorb distortion by the chip and the copper frame.

[0006] Moreover, although the elastic modulus could be made low when using an epoxy resin

which makes crosslinking density small at the time of hardening, for example, the thing which contains an epoxy monomer so much, there was a fault that bond strength fell. Furthermore, if the usual epoxy resin has high viscosity and blends an inorganic filler with this, viscosity will become high too much, ***** at the time of dispensing occurs and workability worsens. In order to improve workability, when a lot of solvents were added, there was a problem that a void occurred.

[0007] Moreover, the conventional resin for mounting needed to be heat-treated in 150-200-degree C oven to hardening for 1 to 2 hours. However, recently, the demand of in-line-izing hardened within 30 minutes in oven is increasing for rationalization like a semi-conductor erector. Although there was the approach of adding a hardening accelerator so much in order to make it fast hardening, the shelf life in ordinary temperature or low temperature, i.e., pot life, and a shell life became short, by 1 liquid type, it is impractical and there was a fault that the bond strength at the time of heat was also low.

[0008]

[Problem(s) to be Solved by the Invention] A poor property, such as a chip crack and IC by curvature, does not happen in combination, such as large-sized chips, such as IC, and a copper frame,, either, but the purpose of this invention is to offer the resin paste which is fast hardening and does not have generating of a void without reducing bond strength at the time of heat.

[0009]

[Means for Solving the Problem] The amount of the nitrogen atom which this invention becomes considering (A) thermosetting resin and (B) inorganic filler as an indispensable component, and is contained in thermosetting resin is the diamond touch paste which is 2 - 10 % of the weight.

[0010] The thermosetting resin (A) used for this invention is common thermosetting resin which consists of resin, a curing agent, a hardening accelerator, etc., and it is required for the amount of the nitrogen atom contained in the thermosetting resin to be 2 - 10 % of the weight. Although firm bond strength is obtained by existing in the component of the resin which the nitrogen atom hardened, since there are also few falls of the bond strength after moisture absorption if there is especially the amount in the range which is 2 - 10 % of the weight, if it uses as a diamond touch paste for semi-conductors, a reliable semiconductor device and a package can be obtained. Furthermore, a nitrogen atom content is 3 - 8 % of the weight preferably. A nitrogen atom content is deficient in the effectiveness of the improvement in bond strength by it being less than 2 % of the weight, and since the polarity of a hardening resin component becomes high too much, water absorption will become large and the bond strength after moisture absorption will fall if 10 % of the weight is exceeded, it is not desirable.

[0011] Although the nitrogen atom may be contained in any of resin, a curing agent, and a hardening accelerator, its hardenability resinous principle is desirable from the point of workability in case a liquefied thing blends in ordinary temperature, and the viscosity after combination.

[0012] The thoria reel isocyanurate which has the aryl group of liquefied cyanate resin, the liquefied epoxy resin of a glycidyl amine mold, and radical polymerization nature as liquefied resin which contains a nitrogen atom in ordinary temperature is mentioned. As what has a nitrogen atom as a curing agent, fatty amine, aromatic amine, a dicyandiamide, a dicarboxylic acid dihydrazide compound, etc. are mentioned as an example. As an example of a dihydrazide compound, carboxylic-acid dihydrazide, such as adipic-acid dihydrazide, dodecanoic acid dihydrazide, isophthalic acid dihydrazide, and P-oxy-benzoic-acid dihydrazide, etc. is mentioned.

[0013] As a hardening accelerator, as those [various kinds of] with an imidazole compound, and its example 2-methylimidazole, 2-ethyl imidazole, 2-phenylimidazole, 2-phenyl-4-

methylimidazole, 2-phenyl-4-methyl-5-hydroxymethylimidazole, 2-phenyl-4, 5-dihydroxymethylimidazole, General imidazoles and triazine, such as a 2-C₁₁H₂₃-imidazole, and isocyanuric acid are added. There are 2 which gave preservation stability, 4-diamino-6-(2-methylimidazole-(1))-ethyl-S-triazine, its isocyanate addition product, etc., and each of these can be used, using together with one kind or two or more sorts.

[0014] The thermosetting resin component which does not contain a nitrogen atom in this invention can be mixed and used for extent in which a property fall does not occur. For example, there are heterocycle type epoxy, such as aliphatic series epoxy, such as bisphenol A, Bisphenol F, a phenol novolak, poly glycidyl ether obtained by the reaction with cresol novolaks and epichlorohydrin, butanediol diglycidyl ether, and neopentyl glycol diglycidyl ether, and diglycidyl hydantoin, vinylcyclohexene dioxide, dicyclopentadiene dioxide, and alicyclic epoxy like ant cyclic diepoxy AJIPEITO, and 1 of kinds of these, and two or more sorts and concomitant use are possible.

[0015] There are silver dust, a silica filler, etc. as an inorganic filler (B) used for this invention.

[0016] Silver dust is used in order to give conductivity, and as for the content of ionicity impurities, such as halogen ion and alkali-metal ion, it is desirable that it is 10 ppm or less.

Moreover, as a configuration of silver dust, the shape of the shape of a flake and resin and spherical ** are used. Although the particle size of the silver dust to be used changes with viscosity of the paste to need, the about 50-micrometer thing of mean particle diameter is [2-10 micrometers and a maximum grain size] usually desirable. Moreover, comparatively coarse silver dust and fine silver dust can also be mixed and used, and various kinds of things may be suitably mixed also about a configuration.

[0017] The silica filler used for this invention is the thing of 50 micrometers or less of maximum grain sizes in the mean particle diameter of 1-20 micrometers. Since a pitch will flow out at the time of spreading or hardening if viscosity will become high if mean particle diameter is less than 1 micrometer, and 20 micrometers is exceeded and bleeding occurs, it is not desirable. If a maximum grain size exceeds 50 micrometers, when applying a paste with a dispenser, the outlet of a needle is taken up and continuous duty of long duration cannot be performed.

Moreover, a comparatively coarse silica filler and a fine silica filler can also be mixed and used, and various kinds of things may be suitably mixed also about a configuration.

[0018] Moreover, in order to give the property needed, inorganic fillers other than this invention may be added.

[0019] Additives, such as a silane coupling agent, a titanate coupling agent, a pigment, a color, a defoaming agent, a surfactant, and a solvent, can be used for the resin paste in this invention within limits which do not spoil the property according to an application as occasion demands. After carrying out preliminary mixing of each component, kneading as a manufacturing method of this invention using 3 rolls etc., for example and obtaining a paste, there is a method of bottom of vacuum de**(ing) etc.

[0020]

[Example] The blending ratio of coal of . each component which explains this invention concretely in the example is taken as the weight section.

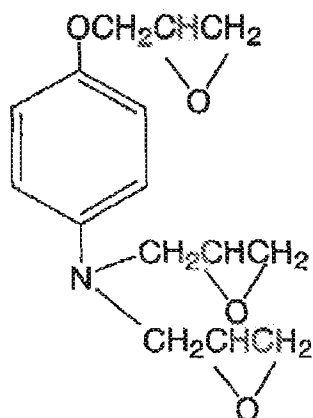
[0021] Each component and the inorganic filler of the presentation shown in examples 1-4 and the <examples 1-5 of comparison> table 1 were blended, it kneaded with 3 rolls, and the resin paste was obtained. The indirect desulfurization bubble of this resin paste was carried out by 2mmHg(s) in the vacuum chamber for 30 minutes, and the diamond touch paste was obtained. The obtained paste evaluated various kinds of engine performance by the following approaches. An evaluation result is shown in Table 1.

[0022] The raw material component to be used is as follows.

- Bisphenol female mold epoxy resin (BPF) : viscosity 5000 mPa-s, weight-per-epoxy-equivalent 170 and a *1:reactivity diluent : PARA tertiary buthylphenyl glycidyl ether and *2: It

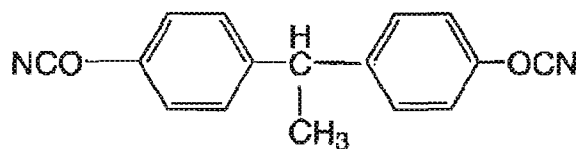
is as a degree type [Formula 1].

式 1



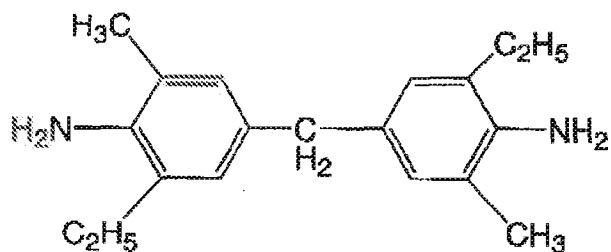
[0023] - *3 : it is as a degree type [Formula 2].

式 2



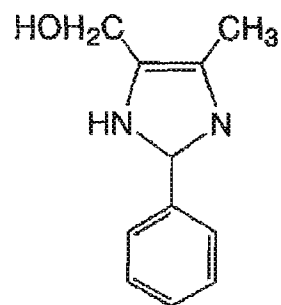
- *4 : it is as a degree type [Formula 3].

式 3



[0024] - *5 : it is as a degree type [Formula 4].

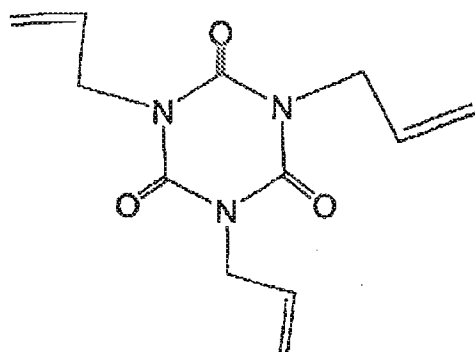
式 4



- Latency curing agent (B) : dicyandiamide (DDA)

[0025] - *6 : it is as a degree type [Formula 5].

式 5



- *71 and 1-screw (t-hexyl peroxy) - 3, 3, 5-trimethyl cyclohexane [0026] - inorganic filler (B): -- silver dust : particle size -- 0.1-50 micrometers -- flake-like silica with a mean particle diameter of 3 micrometers filler: -- the mean particle diameter of 5 micrometers -- silica filler [0027] of 20 micrometers of maximum grain sizes The <evaluation approach> and viscosity : The value in 25 degrees C and 2.5rpm was measured using E mold viscometer (3-degree cone), and it considered as viscosity.

- Bond strength : The 2x2mm silicon chip was mounted on the copper frame using the paste, and it hardened in oven the condition for [in 175 degrees C] 20 minutes. Die share reinforcement was measured using the mounting measuring device after hardening on the strength at the time of heat (25 degrees C and 250 degrees C).

- Pot life : days until the viscosity when leaving a paste in a 25-degree C thermostat thickens to 1.2 or more times of initial viscosity were measured.

[0028]

[Table 1]

		実 施 例				比 較 例			
		1	2	3	4	1	2	3	4
配 合 量	BPF	22.22	8.3			20	20	33	33
	BPGE * 1		8.3	8		8.4	5.7	14	9.5
	アミノフェノールグリニル化物 * 2			20					
	シアネート * 3		33						
	カヤハード * 4	7.78					3.8		6.3
	ジシアニジアミド			0.6					
	2P4MHZ * 5			1.4		1.6	0.5	2.7	0.83
	ナフテン酸コバルト		0.0005						
	ウレタンアクリレート				20				
	TAIC * 6				9				
特 注	パーヘキサ3M * 7				1				
	N原子含有率(wt%)	2.6	7.1	3.5	6.3	0.8	1.51	0.8	1.5
	炭粉	70		70	70	70	70		70
	シリカファイラー		50					50	50
	粘度	230	150	180	200	180	178	200	210
注	接着強度(gf/チップ)@250°C	3500	5400	5800	3900	1800	2200	1700	1800
	接着強度(gf/チップ)	2800	3900	4500	3300	1200	1100	1100	1200
	@250°C(85°C/85%/72Hr)								
注	ポットライフ	2	4	6	4	5	3	5	2

[0029] Although the paste which excelled [examples / 1-4] in bond strength before and after moisture absorption at the time of heat is obtained, since there is little nitrogen atomic weight in a resin hardened material, in the examples 1-4 of a comparison, bond strength is generally obtained only for a low paste. Conversely, in the example 5 of a comparison, since there is too much nitrogen atomic weight, a polarity becomes high and the bond strength after moisture absorption falls.

[0030]

[Effect of the Invention] Fast hardening by oven cure is possible for the diamond touch paste of this invention, and at the time of heat, since bond strength is high, it fits adhesion with large-sized chips, such as IC, and a copper frame, and can prevent a poor property, such as a chip crack like IC erector, and IC by chip distortion.

[Translation done.]